

R E M A R K S

Pages 4, 8 and 12 of the Substitute Specification, which was filed on September 4, 2001, were editorially amended.

Enclosed is a MARKED-UP VERSION OF THE AMENDMENTS TO THE SUBSTITUTE SPECIFICATION.

Claims 5 and 11 were objected to for the reasons set forth at the middle of page 2 of the Office Action.

Claims 5 and 11 were cancelled hereinabove.

Claims 1, 2, 4 to 8, 10 to 12 and 14 were rejected under 35 USC 112, second paragraph for the reasons set forth in the last paragraph on page 2 and the first paragraph on page 3 of the Office Action.

The Examiner objected to the term "conventional alloyed zinc powder".

The meaning of the term "conventional alloyed zinc powder" is well known in the art, as evidenced by the following:

Reference is made to Glaeser USP 5,240,793, column 1, lines 12 to 16, which reads as follows:

"Zinc powder is suitable for use in alkaline batteries only if it exhibits a sufficiently low hydrogen gas evolution in the electrolyte also in the absence of current delivery. To this end, zinc powder in general is passivated with lead and mercury."

Reference is also made to Glaeser USP 5,240,793, column 1, lines 20 to 37, which reads as follows:

"Since presence of mercury is to be avoided in batteries for reasons of environmental protection, many

attempts have already been made to reduce the mercury content by addition of other metals or even to avoid an addition of mercury completely...

.....All conventional zinc powders for alkaline batteries, more specifically if low in or free from mercury contain considerable amounts of lead. These amounts of lead either are present already in the starting material,....., or the lead has been subsequently added as an alloy component to the neat zinc. The amounts of lead added in general are between 0.03 and 3% by weight. For example, 0.05% by weight, corresponding to 500 ppm, of lead are capable of reducing the gas evolution of neat zinc from 1.2 ml/25 g at 70°C within 24 h to 0.10 ml of gas. (emphasis supplied)

Reference is further made to Glaeser USP 5,240,793, column 1, lines 40 to 54, which reads as follows:

"In the meantime, higher importance has also been attached to the toxicity and environmental pollution produced by lead so that there is a demand to reduce the lead content of alkaline batteries. It should be noted that also neat zinc, depending on the processes by which it has been prepared, still contains some residual amounts of lead which, however, are always below 30 ppm, in part below 20 ppm as well or even below 10 ppm.

Now it was surprisingly found that it is also possible to obtain zinc powder having a residual lead content of less than 30 ppm suitable for alkaline batteries, if said zinc powder contains at least 10 to 10,000 ppm, and preferably 100 to 1,000 ppm, of indium and additionally 10 to 10,000 ppm, and preferably 100 to 10,000 ppm, of bismuth."

As is clear from the above quoted passages from USP 5,240,793, the "conventional zinc powders for alkaline batteries" at the time when Glaeser's application was filed meant a zinc powder, which (i) contained considerable amounts of mercury or

(ii) which were low in mercury or free from mercury and contained considerable amounts of lead. The object of Glaeser was to reduce the "considerable amount of lead" still contained in the "conventional zinc powders for alkaline batteries". Glaeser attained such objective by incorporating specified amounts of In and Bi as alloy components of zinc alloys.

As is clearly described in claim 1 of Glaeser, the zinc powder of Glaeser is substantially free from mercury, but has a lead content of less than 30 ppm.

Applicants have informed the undersigned that the "conventional zinc alloyed powder for use in alkaline batteries" at the time the present application was filed was a zinc alloy powder which was substantially free from both mercury and lead (but "less than 10 ppm of lead" is permitted to be called "substantially free from lead" because it is within the range of inevitable impurities of high purity zinc). Thanks to the contributions of Glaeser and other investigators in this field of art, it had been already established at the time of filing the present application to use, as a negative electrode of alkaline batteries, an alloyed zinc powder substantially free from mercury and lead, but which contained, instead of mercury and lead, at least one additional element selected from the group consisting

of Al, Bi, In, Ga, Sn, and the like (see page 2, lines 3 to 5 of the Substitute Specification).

Almost all of the alloyed zinc powders for use in alkaline cells commercially available today, inclusive of the time when the present invention was filed, contain bismuth in an amount including the range of 50 - 1000 ppm based on the weight of the zinc alloy powder for use in the cell (see page 4, last line to page 5, first line of the Substitute Specification).

As explained above, the terminology of "conventional alloyed zinc powder" used in the present application means an alloyed zinc powder substantially free from mercury and lead, but instead contains at least one of Al, Bi, In, Ga, Sn, Pb, etc. This is supported by page 1, lines 2 to 7 of the Substitute Specification and the Comparative Examples set forth in the Substitute Specification, and is also supported by a large number of patent applications recently filed with Patent Offices throughout the world.

Prior to the present invention, the target of investigations in the field of the present invention had been to find additional means to further improve the ability of suppressing the hydrogen gas generation inclusive of how to optimize the ratio of these elements to zinc, etc., but such optimization or the like was not sufficient. This is the reason why the study of the present

invention started. In other words, previous investigations involving this matter had been conducted on the assumption that "conventional alloyed zinc powder for use in alkaline cells", meant a zinc alloy powder which is substantially free from Hg and Pb, but contained at least one of Al, Bi, In, Ga and Sn and includes no more than 10 ppm of Pb. Thus the present specification used the terminology of "conventional alloyed zinc powder" (see page 3, line 6, page 6, lines 5 and 6 , etc., of the Substituted Specification).

It is therefore respectfully submitted that the present claims comply with all the requirements of 35 USC 112.

The above amendments to claims 1 and 2 are supported by page 3, lines 1 to 6 and page 5, lines 6 to 10 of the Substitute Specification.

The above amendments to claims 7 and 8 involving a "powder of Bi" are supported by claim 6.

Enclosed is a MARKED-UP VERSION OF THE AMENDMENTS TO THE CLAIMS.

New claim 15 is supported in the Substitute Specification on page 2, lines 3 to 7.

New claim 16 is supported by Comparative Example 1 on page 10 of the Substitute Specification.

New claim 17 is supported by Comparative Example 2 on pages 11 to 12 of the Substitute Specification.

New claim 18 is supported on pages 1 and 2 of the Substitute Specification.

Prior to the present invention, it was known to alloy at least one of Al, Bi, In, Ga, Sn, etc, into zinc, as is clear from the fact that such alloyed zinc powder is used in the Comparative Examples in the present application. Prior to the present invention, investigations in this field had been directed to further improving the conventional alloyed zinc powder to enhance the ability of suppressing hydrogen gas generation. The present invention achieved such objective by use of a dry mixture of metallic bismuth and a conventional alloyed zinc powder (which usually contains Bi, Al and In, etc.), wherein applied (or dry-mixed) Bi is preferably contained in an amount of 50 - 1000 ppm, and more preferably in an amount of 500 - 1000 ppm. The present invention also relates to a process for producing such a dry mixture.

Moreover, the application of metallic powder of Bi onto the outer surfaces of alloyed zinc particles in an amount of preferably 50 to 1000 ppm, and more preferably 500 to 1000 ppm by dry mixing is the gist of the present invention and this method of application is much more effective than applying Bi onto the grain surfaces of conventional alloyed zinc powder in a solution by making use of the difference in ionizing tendencies. This is

unexpected results?

demonstrated by the enclosed DECLARATION UNDER 37 CFR 1.132 of the inventor, Toshiya KITAMURA, dated November 25, 2002.

Claims 1, 2, 4 to 8, 10 to 12 and 14 were rejected under 35 USC 102 as being anticipated by Glaeser USP 5,240,793.

As is clear from claim 1 of Glaeser, Glaeser relates to an alkaline battery comprising a zinc powder which is substantially free from mercury, but which still contains less than 30 ppm of lead. The effect of lead for suppressing generation of hydrogen gas is great. For this reason, Glaeser could not succeed in eliminating lead from the zinc alloy for use in an alkaline battery. Glaeser succeeded only in reducing the lead content to a level of less than 30 ppm, in particular, to a level of 20 ppm, by the addition of Bi and In, instead of mercury and lead. Later, Glaeser's invention was much more improved by many investigators, and at the time when the present application was filed, it was known to use an alloyed zinc containing at least one of Al, Bi, In, Ga, Sn, etc. in their optimum amount. This is supported by the fact that in the Comparative Examples in the present invention an alloyed zinc containing Al, Bi and In is used.

In contrast to Glaeser, the present inventor aimed to further improve an alloyed zinc powder for use in an alkaline battery, which alloyed zinc is substantially free from mercury

and lead, but contains, instead of Hg and Pb, optimum amounts of Al, Bi, In, etc..

Thus, at the time of filing the present application, Glaeser's invention was no more than one of the prior art publications.

The Examiner took the position that Glaeser teaches a zinc powder for alkaline batteries having an indium content of 10 to 10,000 ppm and additionally contains 10 to 10,000 ppm bismuth (middle of page 7 of the March 28, 2001 Office Action (Paper No. 3)).

As discussed above, "alloying zinc" was one of the established techniques for controlling hydrogen generation from zinc powder to be used in an alkaline cell. Stated differently, for alloying zinc, zinc alloys including some components selected from the group consisting of Al, Bi, In, Ga, Sn, Pb, and the like, have heretofore primarily been used in a manner that a ratio of these elements to zinc was optimized relative to gas generation. Such a zinc alloy powder containing optimized amounts of additional elements such as Al, Bi, In, etc., is referred to as "conventional alloyed zinc powder" in applicant's specification.

However, to realize only such optimization ratio is not sufficient (see page 2, lines 2 to 7 of the Substitute Specification). This means that by changing the amounts of the

components mentioned above, a zinc alloy can be prepared so that the amount of gas generation can be minimized when used in the negative electrode active material. However, there is a certain limit with respect to suppressing hydrogen gas generation. The problem is that this result was not satisfactory for consumers.

Glaeser does not teach or suggest how one can solve this problem and improve the insufficient results of controlling gas generation.

The present inventor discovered that the addition of a powder of Bi to a "conventional alloyed zinc powder" to provide a dry mixture for use in a cell substantially improves the conventional alloyed zinc powder and produces a new product having an enhanced result for suppressing hydrogen gas generation. The addition of Bi powder is very effective as shown in Table 1 on page 11 of the Substitute Specification and in Fig. 1 of the present application, which are reproduced as follows:

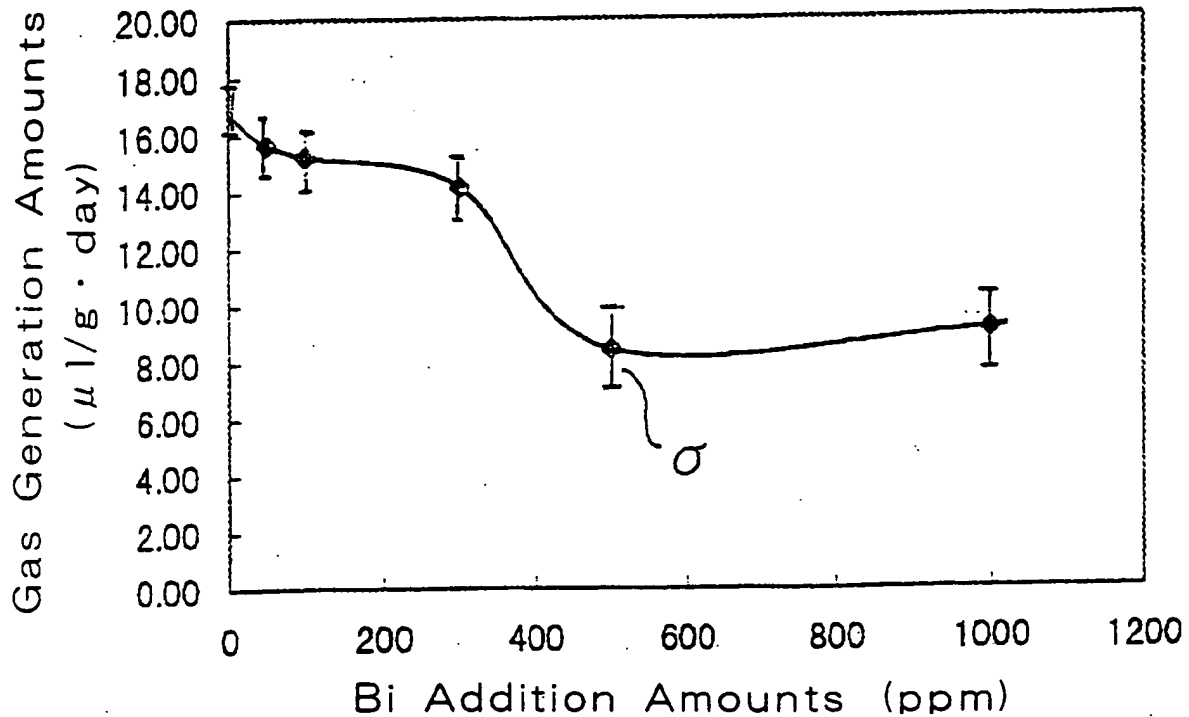
Table 1

	(μl/g · day)				
	Addition Amounts of Metallic Bi Powder (ppm)				
	50	100	300	500	1000
No. 1	16.52	16.34	14.61	9.99	10.31
No. 2	14.37	14.80	14.49	7.73	4.67
No. 3	17.53	15.81	14.73	8.21	8.90
No. 4	15.38	15.02	15.90	9.34	11.94
No. 5	14.50	14.3	11.07	6.93	9.77
Average	15.66	15.25	14.16	8.44	9.12
Standard Deviation	1.353	0.815	1.817	1.230	2.722



Fig. 1

Metallic Bi Mixing Effects



Accordingly, it is respectfully submitted that the presently claimed invention is not anticipated and not rendered obvious by Glaeser.

Claims 1, 2, 7, 8 and 14 were rejected under 35 USC 102 as being anticipated by Miyasaka JP 5-151968 for the reasons set forth in the paragraph bridging pages 3 and 4 of the Office Action.

Claim 6 was rejected under 35 USC 102/103 as being anticipated by, and alternatively unpatentable over, Miyasaka et al. JP 5-151968 for the reasons set forth at the bottom of page 4 of the Office Action.

The Office Action admitted that Miyasaka et al. does not explicitly state that the bismuth powder and alloyed zinc powder are dry mixed.

Submitted herewith is an English language translation of JP 5-151968.

In Miyasaka et al., a bismuth coating onto the surfaces of zinc alloy particles is carried out in an aqueous solution containing nitrate ions. In contrast to Miyasaka et al., in the present invention, the application of bismuth is conducted by dry mixing a powder of metallic bismuth with a powder of the conventional alloyed zinc.

In the case of Miyasaka et al., since nitrate ions are harmful to cell performance if they contaminate the anode gel of the cell, they must be completely removed before the preparation of the gel. Accordingly, the zinc powder must be first separated by filtration from the liquid in which a bismuth coating is carried out and then the separated powder must be fully washed with a substantial amount of pure water, followed by dehydration and complete drying. Thus, the process of Miyasaka et al. is very complicated. In contrast to Miyasaka et al., in the present

invention, it is enough to simply mix a dry powder of metallic bismuth with a dry alloyed zinc powder. Nevertheless, regarding the suppression of gas generation, the present invention is unexpectedly much better than Miyasaka et al., as is demonstrated by the comparative experiments set forth in the enclosed DECLARATION UNDER 37 CFR 1.132 of Toshiya KITAMURA.

The results of Tables 1 to 6 involving Experiments conducted according to Miyasaka et al. as set forth in the enclosed KITAMURA DECLARATION are summarized in Table 7 on page 5 thereof, which is reproduced as follows:

Table 7

Amount of Bi-coating	Amount of gas evolution Average (μ l/g • day)
Experiment 1 (0 ppm)	13.1
Experiment 2 (50 ppm)	28.3
Experiment 3 (100 ppm)	17.8
Experiment 4 (300 ppm)	16.6
Experiment 5 (500 ppm)	13.3
Experiment 6 (1000 ppm)	18.7

Table 8 on page 6 of the KITAMURA DECLARATION is reproduced as follows:

Table 8

	Amount of metallic bismuth powder <u>dry-mixed</u> with the alloyed zinc powder according to the present invention (ppm)				
	50	100	300	500	1000
No. 1	13.9	12.2	5.3	3.0	4.7
No. 2	15.8	8.5	6.5	3.0	5.2
No. 3	11.7	7.8	4.6	5.4	2.9
No. 4	12.8	10.2	4.6	8.2	8.4
No. 5	15.0	11.3	9.4	2.5	5.9
Average	14.4	10.0	6.0	4.4	5.4

amount of
gas evolution

The above results show that the presently claimed invention provides superior suppression of gas generation.

Moreover, in Miyasaka et al., even if the amount of the coating bismuth is increased, the effect of suppressing gas generation is not improved. In contrast to Miyasaka et al., in the case of the present invention, the effect of suppressing gas generation is largely improved when bismuth is applied in an amount of 500 ppm or more (see Fig. 1 of the present application).

As is clear from the above explanation, the process of the present invention is very simple and easy to practice, and yet the effect is much greater than the case of Miyasaka et al.

It is therefore respectfully submitted that applicant's claimed invention is not anticipated and is not rendered obvious by Miyasaka et al.

Reconsideration is requested. Allowance is solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

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- Encs.: (1) PETITION FOR EXTENSION
(2) MARKED-UP VERSION OF THE AMENDMENTS TO THE
SUBSTITUTE SPECIFICATION
(3) MARKED-UP VERSION OF THE AMENDMENTS
TO THE CLAIMS
(4) DECLARATION UNDER 37 CFR 1.132 OF TOSHIYA KITAMURA
DATED NOVEMBER 25, 2002
(5) ENGLISH LANGUAGE TRANSLATION OF JP 5-151968

MARKED-UP VERSION OF THE AMENDMENTS TO THE CLAIMS

1. (Thrice Amended) A negative electrode active material for use in an alkaline cell comprising a dry mixture of a conventional alloyed zinc powder and a powder of Bi as an additional metal.

2. (Thrice Amended) A negative electrode active material for use in an alkaline cell comprising a dry mixture of a conventional alloyed zinc powder and a powder of Bi as an additional metal incorporated in said mixture in an amount of 50 - 1000 ppm by weight based on the amount of said conventional alloyed powder.

6. (Thrice Amended) A negative electrode active material for use in an alkaline cell of low gas generation comprising a mixture of a powder of Bi and a conventional alloyed zinc powder, said mixture being prepared by dry mixing said [metallic] powder of Bi and said conventional alloyed zinc powder.

7. (Thrice Amended) A method of preparing a negative electrode active material for use in an alkaline cell comprising [the step of] mixing a conventional alloyed zinc powder with a powder of Bi as an additional metal.

8. (Thrice Amended) A method of preparing a negative electrode active material for use in an alkaline cell comprising [the step of] mixing a conventional alloyed zinc powder with a powder of Bi as an additional metal, said additional metal being added in an amount of 50 to 1000 ppm by weight based on the weight of the conventional alloyed zinc powder.

12. (Thrice Amended) A method of preparing a negative electrode active material for use in an alkaline cell of low gas generation comprising [the step of] dry mixing a conventional alloyed zinc powder with a powder of Bi.



**MARKED-UP VERSION OF THE AMENDMENTS
TO THE SUBSTITUTE SPECIFICATION**

Page 4, second paragraph of the Substitute Specification:

--In accordance with another aspect of the present invention, there is provided the negative electrode active material for use in the alkaline cell as described above, with an average particle size of 100 [/] μm or less.--

Page 8, second paragraph of the Substitute Specification:

--It is considered that P_{O_2} is constant in this case so that formula (5) can be restated as follows:

$$K_i' = [Zn_i \bullet] \cdot [e^-] \quad (6) \text{ --.}$$

Page 12, last paragraph of the Substitute Specification:

--From the test results, it has been confirmed that mixing of metallic indium is effective in controlling gas generation, since the gas[.] generation was gradually decreased with an increase of metallic indium mixing in each sample.--